JC19 Rec'd PCT/PTO 25 MAY 2001

FORM PTO-1390 (REV 12-29-99) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	
A01105US (98486.2US)	
U.S. APPLICATION NO. (If known, see 37 CFR 1.5)	
09/856781	
INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE
PCT/GB99/03880	19 November 1999 (19.11.99)
PRIORITY DATE CLAIMED	
26 November 1998 (26.11.98)	

TITLE OF INVENTION: LOAD-BEARING STRUCTURES

APPLICANT(S) FOR DO/EO/US: SMITH, James, Leonard

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
3. [ ] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. [X] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [X] is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [X] has been transmitted by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [ ] A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. [X] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [ ] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [ ] have been transmitted by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [X] have not been made and will not be made.
8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [ ] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [X] A FIRST preliminary amendment.
    [ ] A SECOND or SUBSEQUENT preliminary amendment.
14. [ ] A substitute specification.
15. [ ] A change of power of attorney and/or address letter.
16. [ ] Other items or information:

US APPLICATION NO (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/856781		A01105US (98486.2US)

17. [X] The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):	CALCULATIONS PTO USE ONLY
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO $970.00	
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO $840.00	
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO $690.00	
International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) $670.00	
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) $96.00	
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 840
Surcharge of $130.00 for furnishing the oath or declaration later than [ ] 20 [X] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$ 130

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	43 -20 =	20	X $18.00	$ 414
Independent claims	3 -3 =	-0-	X $78.00	$ -0-
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $260.00	$ -0-
TOTAL OF ABOVE CALCULATIONS =				$1,384
Reduction of 1/2 for filing by small entity, if applicable. A Small Entity Statement must also by filed (Note 37 CFR 1.9, 1.27, 1.28).				$
SUBTOTAL =				$1,384
Processing fee of $130.00 for furnishing the English translation later than [ ]20 [ ]30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$
TOTAL NATIONAL FEE =				$1,384
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property +				$
TOTAL FEES ENCLOSED =				$1,384
			Amount to be: refunded	$
			charged	$

a. [X] A check in the amount of $1,384 to cover the above fees is enclosed.

b. [ ] Please charge my Deposit Account No. _____ in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 50-0694. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

GREGORY C. SMITH
GARVEY, SMITH, NEHRBASS & DOODY, L.L.C.
3838 North Causeway Blvd., Suite 3290
Three Lakeway Center
Metairie, LA 70002
US

22920

PATENT TRADEMARK OFFICE

SIGNATURE:

BRETT A. NORTH

NAME

42,040

REGISTRATION NUMBER

CERTIFICATE OF EXPRESS MAILING

I hereby certify that Transmittal Letter Form 1390, Preliminary Amendment, WIPO Publication WO 00/31356, International Search Report, Written Opinion, and Ck # 7172 for $1,384 are being deposited with the United States Postal Service as Express Mail, Label No. **EL444166296US**, in an envelope addressed to: Assistant Commissioner for Patents, Box Patent Application, Washington, D.C. 20231-9999, on 25th May, 2001.

Jacqueline Smith
Signature of Person Mailing Application

Jacqueline Smith
(Typed or printed name of person signing)

GARVEY, SMITH, NEHRBASS & DOODY, L.L.C.
3838 N. Causeway Blvd., Suite 3290
Metairie, LA 70002
Phone: (504) 835-2000
Fax: (504) 835-2070

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT(S): SMITH, James, Leonard

GROUP ART UNIT:

FILED: Herewith EXAMINER:

ENTERING NATIONAL STAGE FROM:
PCT/GB99/03880 (with international filing date 19 November 1999)

FOR: "LOAD-BEARING STRUCTURES"

ATTORNEY DOCKET NO.: A01105US (98486.2US)

* * * * * * * * * * * * * * * * *

PRELIMINARY AMENDMENT

Commissioner of Patents
and Trademarks
Washington, D.C. 20231

Sir:

Please amend the application as follows:

IN THE SPECIFICATION:

Please amend the specification as follows (a marked up version of the amended paragraphs are included in Appendix A)

Item (71) should be replaced with the following paragraph:

- - (71) Applicant (for all designated States except US): MITIE PLASTICS LIMITED [GB/GB]; Trinity Street, Off Tat Bank Road, Oldbury, West Midlands B69 4LA (GB). - -

Item (75) should be replaced with the following paragraph:

- - (75) Inventor/Applicant (for US only): SMITH, James, Leonard [GB/–]; The Penthouse, 19 Japonica House, Woburn Hill Park, Weybridge KT16 2NZ (GB).

- -

IN THE CLAIMS:

Please amend the claims to read as follows (a marked up version of the amended claims is included in Appendix A). To facilitate prosecution all claims (even those not amended) are shown below:

-- 1. A load bearing structural element extruded from a thermoplastic plastics material which is compounded so that the element has a flexural modulus of 400 Mpa or above.

2. An element as claimed in claim 1, which has a flexural modulus of 5500 Mpa or above.

3. (Amended) An element as claimed in claim 1, which has a ratio of flexural modulus in Megapascals to density in kg/m^3 of at least 2.5:1.

4. An element as claimed in claim 3, wherein said ratio is at least 4.2:1.

5. (Amended) An element as claimed in claim 1, which comprises from 30-90 wt% of thermoplastic polymer and 25-50 wt% of an elastic modulus increasing material.

6. (Amended) An element as claimed in claim 1, wherein the thermoplastic polymer is polyethylene, polypropylene or polyethylene terephthalate.

7. An element as claimed in claim 6, wherein the thermoplastic polymer is bi-axially oriented polypropylene.

8. (Amended) An element as claimed in claim 1, wherein the thermosplastic plastics material is a recycled material.

9. (Amended) An element as claimed in claim 1 which contains glass fibres as an elastic modulus increasing material.

10. An element as claimed in claim 9, wherein the glass fibres have a length of at least 5 mm.

11. An element as claimed in claim 10, wherein the glass fibres have a length of 8-12 mm.

12. (Amended) An element as claimed in claim 9 wherein the glass fibres are oriented in planes parallel to a load bearing surface thereof.

13. (Amended) An element as claimed in claim 1, which has compounded with the thermosplastic plastics material at least one substance selected from fire retardants, UV stabilisers and/or friction increasers.

14. (Amended) An element as claimed in claim 1 which has at least one substance selected from fire retardants, UV stabilisers and/or friction increasers present in an outer layer which has a thickness of up to 1 mm.

15. (Amended) An element as claimed in claim 14, wherein the outer layer is formed from thermoplastics material containing the at least one substance and co-extruded with the remainder of the material forming said element.

16. (Amended) An element as claimed in claim 1, which has a co-extruded outer layer which has anti-slip character.

17. (Amended) An element as claimed in claim 1 wherein the compounded thermoplastic plastics material contains a coupling agent and/or a nucleating agent in amounts of from 1 to 3 wt% and 0.1 to 2 wt% respectively. - -

Please add the following new claims:

- - 18. (New) A method of providing access by foot to a location to which access is required, which comprises locating between a freely accessible location and the location to which access is required so as to be supported in such a way that an unsupported span exists between support positions a platform structure which resists static and/or dynamic loading, characterized in that the platform structure is formed as a thermoplastic plastics extrudate which is compounded so that the structure has a flexural modulus of at least 4000 Mpa.

19. (New) A method as claimed in claim 18, wherein the compounded plastics extrudate has a flexural modulus of 5500 Mpa or above.

20. (New) A method as claimed in claim 18, wherein the ratio of flexural modulus in Megapascals to density in kg/m^3 of plastics material of the compounded plastics material is at least 2.5:1.

21. (New) A method as claimed in claim 20, wherein said ratio is at least 4.2:1.

22. (New) A method as claimed in claim 18, wherein the compounded plastics extrudate comprises from 30-90 wt% of thermosplastic polymer and 25-50 wt% of an elastic modulus increasing material.

23. (New) A method as claimed in claim 18, wherein the thermoplastic polymer is polyethylene, polypropylene or polyethylene terephthalate.

24. (New) A method as claimed in claim 23, wherein the thermoplastic polymer is bi-axially oriented polypropylene.

25. (New) A method as claimed in claim 18, wherein the thermoplastic plastics material is a recycled material.

26. (New) A method as claimed in claim 18, wherein the compounded plastics extrudate contains glass fibres as an elastic modulus increasing material.

27. (New) A method as claimed in claim 26, wherein the glass fibres have a length of at least 5mm.

28. (New) A method as claimed in claim 27, wherein the glass fibres have a length of 8-12 mm.

29. (New) A method as claimed in claim 26, wherein the glass fibres are oriented in planes parallel to a load bearing surface of the compounded plastics extrudate.

30. (New) A method as claimed in claim 18, wherein the plastics extrudate has at least one substance selected from fire retardants, UV stabilisers and/or friction increasers compounded therein.

31. (New) A method as claimed in claim 18, wherein the compounded plastics extrudate has at least one substance selected from fire retardants, UV stabilisers and/or friction increasers present in an outer layer of the structure which has a thickness of up to 1 mm.

32. (New) A method as claimed in claim 31, wherein the outer layer is formed from thermoplastic plastics material containing the at least one substance and co-extruded with the remainder of the material forming said structure.

33. (New) A method as claimed in claim 18, wherein the structure has a co-extruded outer layer which has anti-slip character.

34. (New) A method as claimed in claim 18 wherein the compounded plastics extrudate contains a coupling agent and/or a nucleating agent in amounts of from 1 to 3 wt% and 0.1 to 2 wt% respectively.

35. (New) A method of constraining concrete undergoing casting, which comprises employing in the casting a formwork panel structure which resists static and/or dynamic loading when it is supported in such a way than an unsupported span exists between support positions, characterized in that the formwork panel structure is formed as a thermoplastic plastics extrudate which is compounded so that the panel has a flexural modulus of at least 4000 MPa.

36. (New) A method as claimed in claim 35, wherein the compounded plastics extrudate comprises from 30-90 wt% of thermosplastic polymer and 25-50 wt% of an elastic modulus increasing material.

37. (New) A method as claimed in claim 35, wherein the thermoplastic polymer is polyethylene, polypropylene or polyethylene terephthalate.

38. (New) A method as claimed in claim 35, wherein the thermoplastic plastics material is a recycled material.

39. (New) A method as claimed in claim 35, wherein the compounded plastics extrudate contains glass fibres as an elastic modulus increasing material.

40. (New) A method as claimed in claim 39, wherein the glass fibres are oriented in planes parallel to a load bearing surface of the compounded plastics extrudate.

41. (New) A method as claimed in claim 35, wherein the compounded plastics extrudate has at least one substance selected from fire retardants, UV stabilisers and/or friction increasers present in an outer layer of the structure which has a thickness of up to 1 mm.

42. (New) A method as claimed in claim 41, wherein the outer layer is formed from thermoplastic plastics material containing the at least one substance and co-extruded with the remainder of the material forming said structure.

43. (New) A method as claimed in claim 35 wherein the compounded plastics extrudate contains a coupling agent and/or a nucleating agent in amounts of from 1 to 3 wt% and 0.1 to 2 wt% respectively. - -

REMARKS

Applicant respectfully submits that the application is in condition for allowance. A Notice of Allowance is hereby respectfully requested.

Should the Examiner feel that a telephone conference would advance the prosecution of this application, he is encouraged to contact the undersigned at the telephone number listed below.

Applicant respectfully petitions the Commissioner for any extension of time necessary to render this paper timely.

Please charge any fees due or credit any overpayment to Deposit Account No. 50-0694.

Respectfully submitted,

Charles C. Garvey, Jr., Reg. No. 27,889
Gregory C. Smith, Reg. No. 29,441
Seth M. Nehrbass, Reg. No. 31,281
Stephen R. Doody, Reg. No. 29,062
H. Roy Berkenstock, Reg. No. 24,719
Brett A. North, Reg. No. 42,040
GARVEY, SMITH, NEHRBASS & DOODY, L.L.C.
PTO Customer No. 22920
3838 N. Causeway Blvd., Suite 3290
Metairie, LA 70002
Tel.: (504) 835-2000
Fax: 504-835-2070
e-mail: IPLNO@AOL.COM

APPENDIX A - - MARKED UP VERSIONS SHOWING AMENDMENTS

SPECIFICATION

The following amendments were requested in items (71) and (75) of the specification.

- - (71) Applicant (for all designated States except US): MITIE PLASTICS LIMITED [GB/GB]; [1 Bell Street, Maidenhead, Berks SL6 1BU]Trinity Street, Off Tat Bank Road, Oldbury, West Midlands B69 4LA (GB). - -

- - (75) Inventor/Applicant (for US only): SMITH, James, Leonard [GB/–];[Smith Street, P.O. Box 166, St. Peter Port, Guernsey GY1 1EZ] The Penthouse, 19 Japonica House, Woburn Hill Park, Weybridge KT16 2NZ (GB). - -

CLAIMS

- - 3. (Amended) An element as claimed in claim 1[or 2], which has a ratio of flexural modulus [(]in Megapascals[)] to density [(]in kg/m^3[)] of at least 2.5:1.

5. (Amended) An element as claimed in [any preceding] claim 1, which comprises from 30-90 wt% of thermoplastic polymer and 25-50 wt% of an elastic modulus increasing material.

6. (Amended) An element as claimed in [any preceding] claim 1, wherein the thermoplastic polymer is polyethylene, polypropylene or polyethylene terephthalate.

8. (Amended) An element as claimed in [any preceding] claim 1, wherein the thermosplastic plastics material is a recycled material.

9. (Amended) An element as claimed in [any preceding] claim 1 which contains glass fibres as an elastic modulus increasing material.

12. (Amended) An element as claimed in claim 9[, 10 or 11,] wherein the glass fibres are oriented in planes parallel to a load bearing surface thereof.

13. (Amended) An element as claimed in [any preceding] claim 1, which has compounded with the thermosplastic plastics material at least one [or more] substance[s] selected from fire retardants, UV stabilisers and/or friction increasers.

14. (Amended) An element as claimed in [any preceding] claim 1 which has at least one [or more] substance[s] selected from fire retardants, UV stabilisers and/or friction increasers present in an outer layer which has a thickness of up to 1 mm.

15. (Amended) An element as claimed in claim 14, wherein the outer layer is formed from thermoplastics material containing [said substance(s)]the at least one substance and co-extruded with the remainder of the material forming said element.

16. (Amended) An element as claimed in [any preceding] claim 1, which has a co-extruded outer layer which has anti-slip character.

17. (Amended) An element as claimed in [any preceding] claim 1 wherein the compounded thermoplastic plastics material contains a coupling agent and/or a nucleating agent in amounts of from 1 to 3 wt% and 0.1 to 2 wt% respectively. - -

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LOAD-BEARING STRUCTURES

This invention relates to static and dynamic load-bearing structures, in particular but not exclusively to structures for walking on or for retaining wet concrete. The invention relates in particular to scaffold boards, formwork beams and formwork panels.

Scaffold boards and formwork have traditionally been made of wood. Conventional wooden boards used in the construction industry have a gross weight in the range of from about 17 to 30 kg. They are thus heavier than might be desired for handling by a single person and are themselves environmentally undesirable insofar as they represent use of only slowly renewable resources. Cheaper and more rapidly renewable forms of timber are generally unsuitable for reasons, *inter alia*, of strength. However, all wood boards, formwork panels and beams are subject to degradation caused by entry of water. This leads to deterioration of mechanical character, warping and cracking. Particular problems in the tropics are excessive warping because of elevated temperatures and that of attack by insects, for example termites. For this reason, timber boards utilised at outside locations tend only to have a useful life of from about six months to about 15 months.

A further problem with wood scaffolding boards is that timber has a roughish surface in which water can accumulate. This can prove a significant problem under icy conditions when the existence of ice will be difficult to identify and can lead to accidents. Even under normal conditions, the coefficient of friction of wood surfaces is somewhat low and can make scaffold boards slippery, especially when wet. Moreover, a common general problem at building sites is the theft, inter alia, of scaffold boards and formwork panels. The best that has been achieved hitherto with timber

scaffold boards in countering their theft has been to apply a rough printing to the board by continuous rubber stamping or to paint the ends of the board using a characteristic colour combination. The first type of security measure may be difficult to observe and the second can be readily circumvented by a thief merely by sawing off the ends.

It is an object of the present invention to provide a low cost alternative to a wooden scaffold board or formwork screen panel of conventional type which, as much as possible, is free from the problems set out above.

According to one aspect of the present invention, there is provided a load bearing structural element formed from a preferably recycled thermoplastic plastics material which is compounded so that the element has a flexural modulus of 4000 MPa or above.

Preferably, the flexural modulus is 5500 MPa or above.

A characteristic feature of the material used to form structural elements embodying the invention is flexural modulus, also known as flexural stiffness or elastic modulus. This can be predicted by supporting the structural element across its recommended maximum span, applying a centred load and using the following equation:

$$E = \frac{F(2L^3 - Lb^2 + (b^3/4)}{96yi}$$

where:

E = Elastic modulus (in Pascals)

F = Load (in Newtons)

i = 2nd moment of inertia of structural element's cross section (in m^4)

L = Span (in metres)

b = Centred space of load distribution (in metres)
y = maximum deflection, absolute value (in metres).

Similar results can be obtained from a distributed load such as would be experience by formwork.

Thus, it is readily possible to establish whether a material will enable a structural element produced therefrom to possess a flexural modulus as required by the present invention.

For a narrow scaffold board having an external maximum section of 230 x 45 mm and a length of 3900 mm, when:

F = 1500 N
$i \leq 12 \times 10^{-7}$ in m^4
L = 1.5 m
b = 0.5 m
$y \leq 0.015$ m,

duration of load = 168 hours

the flexural modulus will be greater than 5500 MPa.

The flexural modulus (elastic modulus) of a structural element embodying this invention can be calculated from the deflections. Rods made of the compositions and having a diameter of less than 35 mm are simply supported across a span greater than 340 mm. A sustained load of 31 kilograms is applied to the centre of the rods so that the "ultimate elastic modulus" is considered to be reached when deflection remains unchanged for five days under a constant temperature of 45 °C.

Preferably, a structural element in accordance with the present invention has a ratio of flexural modulus (in Megapascals) to density (kg/m^3) of at least 2.5:1. Preferably, the ratio is at least 3:1, more

preferably at least 4.2:1.

The density of a particular structural element can be easily determined and, using the equation above, the ratio can be easily calculated.

Thus, for a narrow scaffold board having an external maximum section of 230 x 45 mm and a length of 3900 mm mentioned above, which has a density of less than 1300 kg/m^3, the ratio of flexural modulus to density will be 4.2:1.

Structural elements in accordance with the invention can have a stiffness which exceeds the deflection standards set out in European draft legislation EN12811, a creep which satisfies creep standards established by the European Health & Safety Executive over an ambient temperature range of -20 to 50°C, an impact resistance in excess of standards set by the European Health & Safety Executive and as measured at a temperature of -20°C and which has twice the impact strength of dry timber at 20 °C. Preferably, the element meets the specification for a timber scaffold board as described by BS2482:1971

In accordance with the present invention, there is provided a structural element which preferably comprises an extruded plastics composition which comprises 30-90 wt% of thermoplastic polymer, and 10-60 wt% of elastic modulus increasing material.

Preferred amounts of the respective materials are 40-75 wt%, more preferably 50-65 wt%, of thermoplastic polymer, and 25-50 wt%, more preferably 30-45 wt%, of an elastic modulus increasing material.

The thermoplastic polymer may be polyethylene, polypropylene, or polyethylene terephthalate. However, in general, polypropylene is better at resisting creep and is better able to resist lower temperatures, having an operating range generally of -20 + 45°C. The polypropylene is preferably bi-axially oriented

polypropylene (BOPP), which is a common material in packaging and has a low cost for recycling purposes, especially if contaminated with printing inks whose presence precludes most conventional processing techniques.

The elastic modulus increasing material may be glass beads, talcum powder, etc, but it is preferred if it is glass fibres. Such glass fibres are preferably recycled glass fibres because of cost considerations and it is even possible to use glass fibre "fluff". It is preferred if the glass fibres have a length of greater than about 5mm, preferably in the range 8-12 mm, in order to provide the product with additional rigidity.

To enhance the elastic modulus further, the composition may additionally comprise a coupling agent, to enhance bonding between polymer and elastic modulus increasing material and/or a nucleating agent, the latter ensuring a uniform compact microcrystalline structure, in relatively low amounts, such as 1 to 3, preferably 2 wt%, and from 0.1 to 2 wt%, preferably 0.5 wt%, respectively.

Polymer materials employed in the production of product, especially board structures, embodying the invention may have incorporated therein in particular, fire retardants, UV stabilisers and friction increasers. In this way, there is readily obtained a material which is not easy to ignite according to BS476, part 12 and having a low surface spread of flame when tested to BS 476, part 7. The materials utilised can be compounded so as to ensure low emission of toxic fumes in a fire, low emission of smoke in a fire and absence of molten droplets in a fire. Some of these requirements cannot be met by, or are inappropriate for, wooden scaffold boards. Others are potential problems when using plastics materials, which problems

are readily addressed by suitable compounding.

Such materials are preferably present in an outer layer on the product or board which may have a thickness of up to 1 mm, preferably 0.5 mm.

Mention has already been made of problems of slipping on timber scaffold boards. This problem can readily be addressed in the practice of the present invention when, instead of producing the board material as a single extrusion, it is produced as a co-extrusion with an anti-slip surface being provided thereon. For this purpose a thermoplastic polyethylene or polyolefin material such as EPDN or TPO may be provided. Such layer can also contain the other additives mentioned hereinabove as suitable for inclusion in a co-extruded outer layer or be a separate layer. Such a material is however not suitable for use alone because of its inability to meet structural requirements.

A preferred composition of the outer layer comprises up to 80 wt%, preferably about 52 wt%, of thermoplastic olefin (TPO) and up to 20 wt %, preferably 10 wt%, of low density polyethylene (LDPE) which provide anti-slip properties on for example scaffold boards. Such layers, in addition, provides for easy release of concrete where formwork boards and panels such layers also protecting the board or panel front abrasion and scuffing and weaknesses that may be caused by scratching or impact. In addition, the composition may have 25 wt% of a brominated organic compound such as decabromodiphenyl oxide and 12.5 wt% of SbO_3 as flame retardants. A pigment may be added to 0.5 wt%, and a UV additive such as tinuvin to 0.5 wt%.

The structural elements in accordance with the present invention can also be used for decking, system batons, access platforms, boardwalks, walkways, piers, jetties, staging, shuttering, lintels, shelving, telegraph poles, pallets, road humps, fencing,

barriers, seating, benches etc. However, the invention will be described hereinafter primarily with reference to scaffold boards.

Such boards can readily be made by a continuous extrusion process and cut to length so as to be compatible with timber scaffold boards which generally are available in lengths of 3.9 metres, 3.0 metres and 2.4 metres, in each case ± 20 mm and having a width of 225 mm ± 2 mm and a thickness of 45.5 mm ± 0.5 mm. Generally, such planks or boards embodying the invention will be hollow and to ensure that they satisfy the aforementioned physical parameters, they may be provided with internal walls extending longitudinally thereof.

Many advantages are attainable with boards embodying the invention. Firstly, there is a considerable weight reduction. A 3.9 metre long board which is to bridge a 1.5 metre span may have a weight of 18.3 kg compared with 24 kg for a wet timber board. If only a 1.2 metre span has to be bridged, then such a board may be made so as to have only a weight of only about 16.8 kg.

Mention has also been made herein of the restricted lifetime of timber boards. With recycled plastics material, it is possible to produce boards having a life which is a minimum of three times that of timber. No preservative or treatment is required as there will be no susceptibility to fungicidal rot or termite attack. Warping or bowing will not occur and unless the board is severely mistreated, there will be no splintering. The boards are also resistant to acids, alkalis, solvents, detergents, greases and oils which degrade wooden scaffold boards. Resistance to chemicals in concrete is advantageous for formwork applications.

Boards embodying the invention will be free from

hazardous metal plates as are generally used as end protection on wooden scaffold boards and formwork girders. Extrusion methods make it possible to produce radiussed edges. In addition to the safe handling thus made possible, the ends of hollow scaffold boards can be closed off by tightly fitting injection moulded end caps knocked firmly into the open ends of the profile before it has fully cooled down after extrusion. These end caps can be manufactured from unbreakable and resilient plastic material and in a colour which may be indicative of the source of the plank. They can also be employed as water-tight connectors between formwork panels. Better security against theft can be achieved by providing a coloured bead co-extruded along the plank, or continuously embossing or hot foil stamping the name of the owner along the plank possibly on both major faces. These cannot be removed without damaging the plank. Each owner may employ a characteristic colour or pattern. In addition, an embossed tread pattern may be applied to the major faces of the plank.

In addition to providing a co-extruded anti-slip surface, it is possible for an anti-slip surface texture to be embossed or moulded into one or both opposite surfaces of the plank, the surface texture being designed to satisfy or exceed appropriate coefficient of friction standards.

Extrusion of mixes of materials to be utilised in the production of the planks or boards may take place using a high efficiency venting screw such as a Ventus screw. Additionally, one can utilise a rotary channel pump according to WO97/42019 for dosing into an extruder consistent quantities of particulate material such as recycled polymer material, in particular chopped film which may be printed film, ie. low grade material, but not liquid or powder. Such a dosing method avoids granulation of plastics material.

In order to achieve a product with relatively long glass fibres in it, it is necessary to add these fibres after working by the extruder screw used in compounding the material for the board which would otherwise fragment glass fibres to too great an extent. Dispensing of glass fibres and other solid material into matrix passing through the downstream portion of an extruder may be achieved using a flow pump according to EP-A-0467842 for transferring and compacting particulate solids. The glass fibres are also preferably oriented in planes parallel to a load bearing surface thereof by passage through a known multi-layer grid producing multi-layering of glass fibres in the extrudate obtained. This ensures a maximum strength of product. It has also been found that the stiffness of the product is improved if the glass fibres are not of a uniform length.

For a better understanding of the invention and to show how the same can be carried into effect, reference will now be made by way of example only to the accompanying drawings wherein:

Figure 1 shows a set of boards embodying the invention, these being shown in cross-section and each board having an internal web thickness of 5 mm;

Figure 2 is a bar chart showing the results of impact tests on prior art scaffold planks and scaffold planks embodying the invention; and

Figure 3 is a graph of deflection against time for one board embodying this invention.

Referring to Figure 1, there is shown a series of extruded boards embodying the invention and having the following dimensions and weights.

a) plastics toe-board 150 mm x 25 mm in cross-section with 4 mm external wall thickness, the board having a length of 2.49 metres max. and a weight of 3.8 kg.

b) plastics plank 225 mm x 45 mm in cross-section with an external wall thickness of 6 mm and a maximum length of 3.9 m, the plank to be supported at 1.2 m max. centres and having a weight of 14.9 kg.

c) plastics plank 225 mm x 45 mm in cross-section with 7 mm wall thickness and 3.9 m long, to be supported at 1.5 mm max centres, the plank having a weight of 18.3 kg.

d) plastics plank 225 mm x 52 mm in cross-section with 7 mm wall thickness and 3.9 m long, to be supported at 1.8 max centres. The plank has a weight of 19.8 kg.

e) plastics plank 300 mm x 52 mm in cross-section with 7 mm wall thickness and 3.9 m long, to be supported at 1.8 m max centres. The plank has a weight of 24.8 kg.

f) plastics plank 225 mm x 65 mm in cross-section with 7 mm wall thickness and 2.4 m long to be supported at 2.4 m max centres. The plank has a weight of 13.1 kg.

g) plastics system scaffold batten 375 mm x 65 mm in cross-section with 7 mm wall thickness and 2.4 m long, to be supported at 2.4 m max centres. The batten has a weight of 18.5 kg.

h) plastics system scaffold batten 320 mm x 85 mm in cross-section with 7 mm wall thickness and 3.0 m long, to be supported at 3.0 m max centres, the batten having a weight of 23.8 kg.

Boards were manufactured from mixtures having the following compositions:

- Boards a), b) and boards the same as board b) except for a wall thickness of 7 mm

Masterbatch	5 wt%
Biaxially oriented polypropylene (BOPP)	65 wt%
Glass fibre	30 wt%

- Boards the same as board b) but intended to be supported at 1.5 m centres, and such boards with a wall thickness of 7 mm:

Masterbatch	5 wt%
BOPP	53 wt%
Glass fibre	42 wt%

- Boards the same as board f) except for a wall thickness of 6 mm, a length of 3.9 m and intended to be supported at 1.8 m centres; such boards with a wall thickness of 7 mm; board g); boards the same as board g) except for a wall thickness of 6 mm:

Masterbatch	5 wt%
BOPP	55 wt%
Glass fibre	40 wt%

- Board f) and boards the same as board f) except for a wall thickness of 6 mm:

Masterbatch	5 wt%
BOPP	50 wt%
Glass fibre	45 wt%

In each of the above cases, the masterbatch comprises:

Polypropylene	2.8 parts by wt
Coupling agent (maleic anhydride)	2 parts by wt

nucleating agent (MDBS)	0.2 part by wt

It will be appreciated that the amount of glass fibre in the composition is increased when increased stiffness is required, for example, when the boards are intended to be used across larger spans.

Each of the above boards was co-extruded with an 0.5mm thick outer layer which comprises the following:

Thermoplastic olefin (TPO)	51.5 wt%
LDPE	10 wt%
flame retardant (decabromodiphenyl Oxide)	25 wt%
flame retardant (SbO_3)	12.5 wt%
pigment	0.5 wt%
UV additive	0.5 wt%

Tests have been carried out on boards embodying the invention as follows:-

1. Impact test

Testing to new standards proposed by the European Health & Safety Executive, a 50 kilogram dead weight of sand was dropped on to the centre of a plank supported at 1.3 metre centres and lightly restrained at each end. It was required that the board be able to withstand an impact energy of 600 joules. A total of 5 boards were employed. A wet timber scaffold board failed at an impact energy of about 390 joules. Two different dry timber scaffold boards failed at about 590 joules although audible cracks were heard at about 490 joules. A first board embodying the invention did not fail until subject to an impact energy of about 780 joules while a second plastics board did not fail until subject to an impact energy of about 870 joules. The results are illustrated graphically in Figure 2.

2. Deflection Boards

A board embodying the invention was tested to a new standard proposed under BS draft document EN12811 and HD1000. For this purpose, measurement was made of the deflection caused by a load of 1.5 KN applied to an area of 500 mm x 230 mm at the centre of the board, with the board supported between 1.5 metre centres. It is a requirement that deflection must not exceed 1% of the span (a maximum of 15 mm). Measurements were carried out daily after extrusion and cooling. The plank utilised is made of the plastic sample of the second plastics board utilised in the impact test. Deflection values were measured daily and are shown in Figure 3 of the accompanying drawings for which it can be seen that immediate application of the load achieved a deflection of 9.2 mm which increased by another 1 mm over one hour and levelled off at 11.2 mm over the next three days. Upon removal of the loading, a residual deflection of 2 mm was recorded.

3. Strength Test

The superior high temperature strength of plastic boards embodying this invention is demonstrated by results of a test specified by draft European standard EN12811, conducted by the Health & Safety Laboratory. The test involved a sample spanning 1.5m in an environment maintained at 40°C, undergoing a centred static load evenly distributed over 0.5m.

A load pf 594kg broke a standard timber board. A load of 1015kg did not break a plastic board.

CLAIMS

1. A load bearing structural element extruded from a thermoplastic plastics material which is compounded so that the element has a flexural modulus of 4000 MPa or above.

2. An element as claimed in claim 1, which has a flexural modulus of 5500 MPa or above.

3. An element as claimed in claim 1 or 2, which has a ratio of flexural modulus (in Megapascals) to density (in kg/m^3) of at least 2.5:1.

4. An element as claimed in claim 3, wherein said ratio is at least 4.2:1.

5. An element as claimed in any preceding claim, which comprises from 30-90 wt% of thermoplastic polymer and 25-50 wt% of an elastic modulus increasing material.

6. An element as claimed in any preceding claim, wherein the thermoplastic polymer is polyethylene, polypropylene or polyethylene terephthalate.

7. An element as claimed in claim 6, wherein the thermoplastic polymer is bi-axially oriented polypropylene.

8. An element as claimed in any preceding claim, wherein the thermoplastic plastics material is a recycled material.

9. An element as claimed in any preceding claim which contains glass fibres as an elastic modulus increasing

material.

10. An element as claimed in claim 9, wherein the glass fibres have a length of at least 5mm.

11. An element as claimed in claim 10, wherein the glass fibres have a length of 8-12mm.

12. An element as claimed in claim 9, 10 or 11, wherein the glass fibres are oriented in planes parallel to a load bearing surface thereof.

13. An element as claimed in any preceding claim, which has compounded with the thermoplastic plastics material one or more substances selected from fire retardants, UV stabilisers and friction increasers.

14. An element as claimed in any preceding claim which has one or more substances selected from fire retardants, UV stabilisers and friction increasers present in an outer layer which has a thickness of up to 1mm.

15. An element as claimed in claim 14, wherein the outer layer is formed from thermoplastic plastics material containing said substance(s) and co-extruded with the remainder of the material forming said element.

16. An element as claimed in any preceding claim, which has a co-extruded outer layer which has anti-slip character.

17. An element as claimed in any preceding claim wherein the compounded thermoplastic plastics material contains a coupling agent and/or a nucleating agent in

amounts of from 1 to 3 wt% and 0.1 to 2 wt% respectively.

Fig.1a

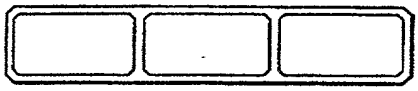

Fig.1b

Fig.1c

Fig.1d

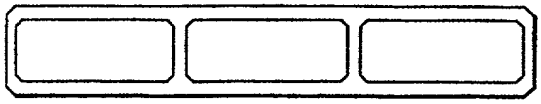

Fig.1e

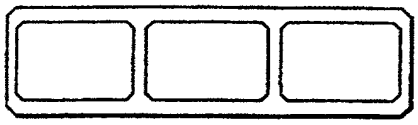

Fig.1f

Fig.1g

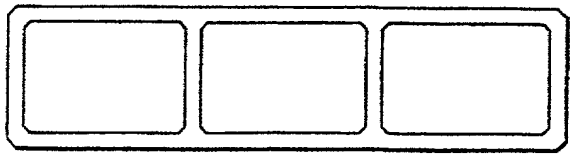

Fig.1h

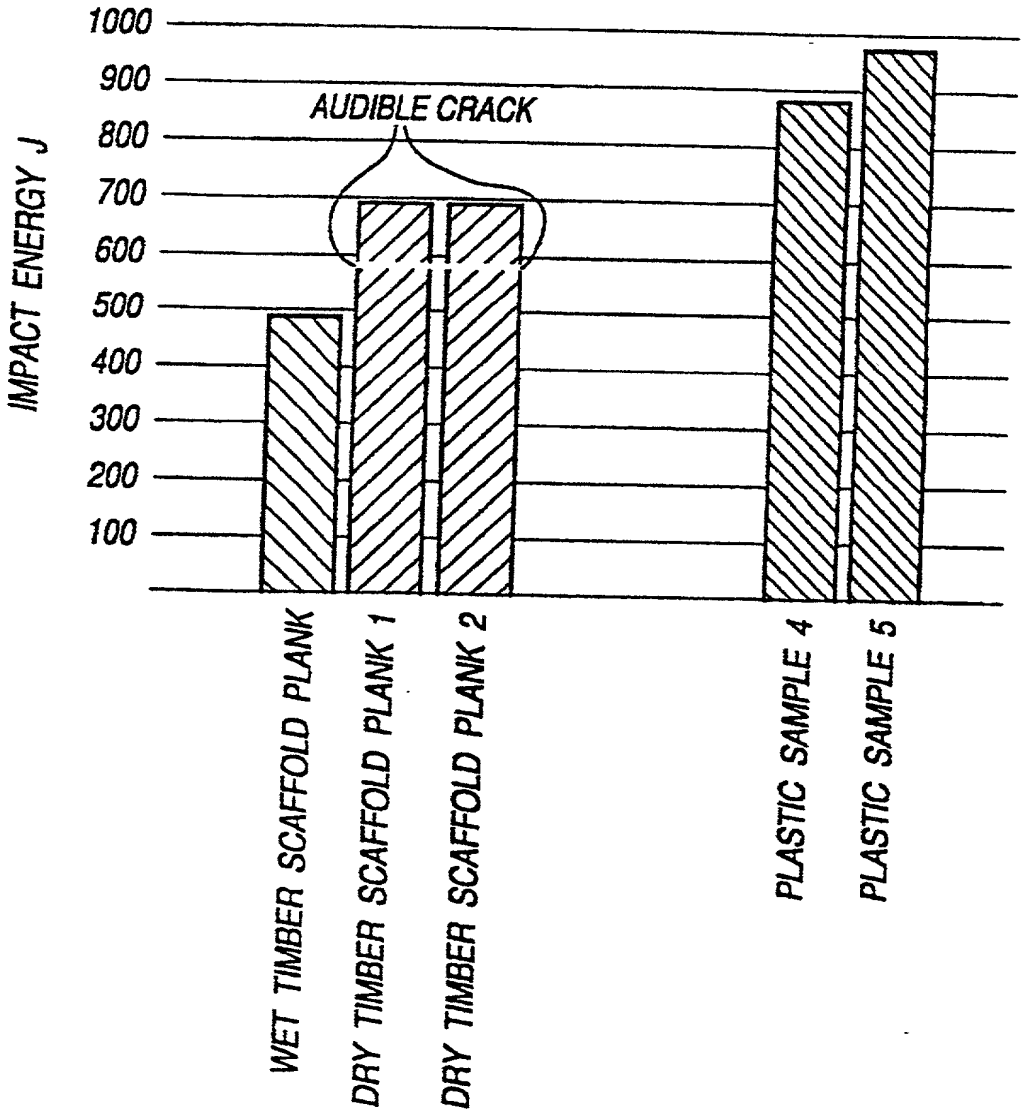
IMPACT ENERGY J
1000
900
800
700
600
500
400
300
200
100
AUDIBLE CRACK
WET TIMBER SCAFFOLD PLANK
DRY TIMBER SCAFFOLD PLANK 1
DRY TIMBER SCAFFOLD PLANK 2
PLASTIC SAMPLE 4
PLASTIC SAMPLE 5

Fig.2

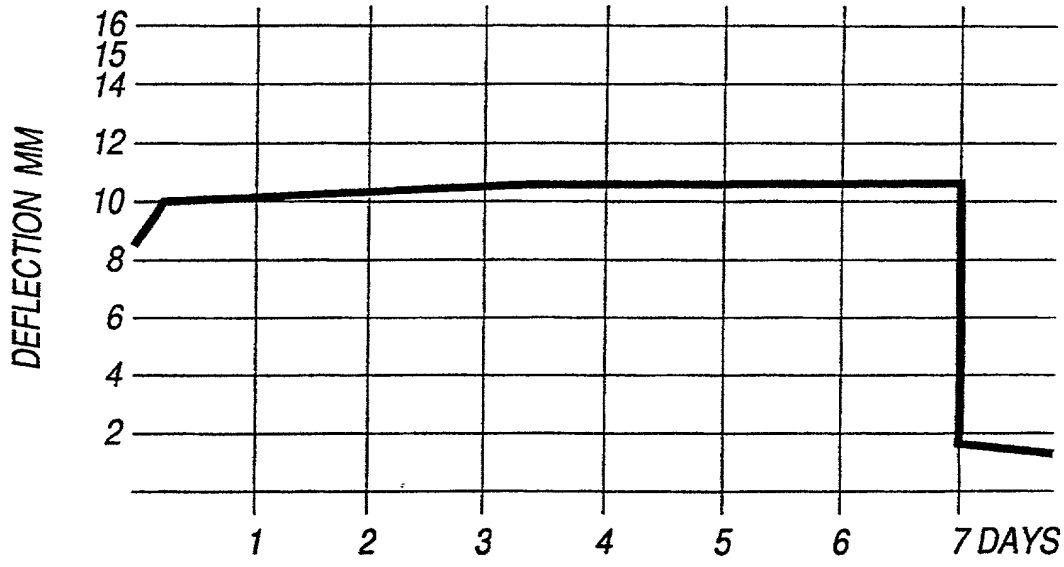

Fig.3

PTO/SB/01 (03-01)
Approved for use through 10/31/2002. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☐ Declaration Submitted with Initial Filing OR ☒ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	A01105US (98486.2)
First Named Inventor	James Leonard Smith
COMPLETE IF KNOWN	
Application Number	09/856,781
Filing Date	May 25, 2001
Group Art Unit	
Examiner Name	

As a below named inventor, I hereby declare that:

My residence, mailing address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

"Load-Bearing Structures"

(Title of the Invention)

the specification of which

☐ is attached hereto

OR

☒ was filed on (MM/DD/YYYY) 11/19/1999 as United States Application Number or PCT International Application Number PCT/GB99/03880 and was amended on (MM/DD/YYYY) 05/25/2001 (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent, inventor's or plant breeder's rights certificato(s), or any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	Certified Copy Attached? NO
9825958.3	Great Britain	11/26/98	☐	☐	☒
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

PTO/SB/01 (03-01)
Approved for use through 10/31/2002. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

NAME OF SOLE OR FIRST INVENTOR : [ ] A petition has been filed for this unsigned inventor

Given Name (first and middle [if any]): James Leonard | Family Name or Surname: Smith

Inventor's Signature | Date: 17.09.01

Residence: City: Weybridge | State | Country: UK GBX | Citizenship: UK

Mailing Address: The Penthouse, 19 Japonica House, Woburn Hill Park,

City: Weybridge | State | ZIP: KT16 2NZ | Country: UK

NAME OF SECOND INVENTOR: [ ] A petition has been filed for this unsigned inventor

Given Name (first and middle [if any]) | Family Name or Surname

Inventor's Signature | Date

Residence: City | State | Country | Citizenship

Mailing Address

City | State | ZIP | Country

[ ] Additional inventors are being named on the ____supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto.